



DISCUSSION

This map sheet shows seismic-reflection profiles from two different surveys of the Offshore of Point Conception map area, providing imagery of the subsurface geology in the westernmost Santa Barbara Channel region. This offshore area is characterized by a relatively flat shelf that decreases in slope (from about 1.1° to 0.7°) from southeast to northwest as the trend of the coastline changes from westward (east of Point Conception) to northward (west of Point Conception).

The high-resolution seismic-reflection profiles displayed on this sheet (figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12) were collected in 2014 on U.S. Geological Survey (USGS) cruise SE-0113–13C, using the SEG SMIle marine seismograph system. This system used a 500-l high-voltage electrical discharge fired 1 to 2 times per second, which, at nominal survey speed of 5.5 m/min, produced approximately 100-m-long traces. The seismic data are recorded by 12-bit digitalized recording based on SEG-Y-2 bit floating-point format, using Triton Subbottom Logger (SBL) software that merges seismic-reflection data with differential GPS-navigation data. At the survey hour, a short-window (20 ms) automatic gain control algorithm was applied to the data, along with a 160- to 1,200-Hz bandpass filter and a heave correction. These uses an automatic seafloor-detector window (averaged over 30 m of lateral distance covered). These steps resolve geological features down to tens of meters thick (and, hence, are considered “high-resolution”), down to sub-bottom depths as deep as 400 m.

Figure 10 shows a grated, deep-penetration, multichannel seismic-reflection profile collected in 1984 by WesternGeco on track W-37-SC-34. This profile and other similar data were collected in many areas offshore of California in the 1970s and 1980s when these areas were considered a frontier for oil and gas exploration. Much of these data have been publicly released and are now archived at the U.S. Geological Survey National Archive of Marine Seismic Surveys (Trizenberg et al., 2016). These data were acquired using a large-volume air-gun source that has a frequency range of 3 to 40 Hz and recorded with a multichannel hydrophone streamer about 2 km long. Shot spacing was about 30 m. These data can resolve geologic features that are 20 to 30 m thick, down to subbottom depths of as much as 4 km.

subbottom depths of up to 4 km. The uppermost 100 m of the sedimentary rocks and uppermost Pleistocene to Holocene sediments (see Fig. 3) are underlain by the Miocene Motu Formation and the upper Miocene and lower Pliocene Sequence. On high-resolution seismic-reflection profiles, these strata commonly yield parallel to subparallel, continuous, variable-amplitude, high-frequency reflectivities (terminology from Mitchum and others, 1977); however, these strata are cut by numerous faults and commonly are folded, in many places too steeply folded to be imaged on seismic profiles. In some places, the strata are folded so much that they are overturned and are thus inverted on the seismic profiles. This effect has been referred to as "gas blanking," "acoustic turbidity," or "acoustic masking" (Hovland and Judd, 1988; Fader, 1997). The gas scatters or attenuates the acoustic energy, preventing penetration. Not surprisingly, this effect is especially prevalent offshore of Point Conception where numerous large faults are present.

nephral muds (see Figs. 5 through 9) and peckmark features are present on the seafloor (see also, sheet 9). The area immediately adjacent to the shelf edge contains numerous small-scale, low-relief features. At Point Conception map area, Surficial and shallow sediments were deposited on the shelf in the last about 21,000 years during the sea-level rise that followed the last glacial maximum and the Last Glacial Maximum (LGM) (Stanford and others, 2011). Global sea level was about 120 to 130 m lower during the LGM, at which time the shelf around Point Conception was emergent. The post-LGM sea-level rise was rapid (about 9% in ten thousand years) until about 8,000 years ago, when it slowed down and continued to rise gradually. Sedimentation rates were higher where the sediments deposited on the shelf during the post-LGM sea-level rise (above a transgressive surface of erosion) are shaded blue in the high-resolution seismic-reflection profiles (Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12), and their thicknesses are shown on sheet 9C. On most profiles, the base of the post-LGM depositional unit is a flat to concave,

High-resolution seismic-reflection profiles in the Offshore Point Conception map area primarily show Neogene strata that, on a larger scale, are folded within a large, east-west-trending homocline that extends from the south flank of the Santa Ynez Mountains (see Fig. 1–2 in purple) into the offshore to both the south and west. The section is based along the same profile as the seismic-reflection system (Fig. 1–3 in purple) as indicated on nearby regional sections (Redin and others, 2005) and on industry seismic reflection (see, for example, Fig. 10; also see, Sorlien and Nicholson, 2015). The tip of the fault system is inferred to be buried to a depth of about 2 to 3 km below sea level (about 1.5 to 2 sec two-way travel time [TWT]) about 4 to 6 km offshore, beneath the slope on the north flank of the Santa Barbara Basin.

Closely spaced strike-slip reflections profiles reveal many shallow, west-northwest-striking faults that have variable geometries, lengths, amplitudes, degrees of continuity, and wavelengths. The Government Point Syncline, which is the most prominent fold, has been mapped both onshore at Point Conception (Dibblee, 1988a) and offshore to the west and east of Point Conception; the syncline has a cumulative length of more than 22 km (see sheet 9). Local thickening of post-LGM sediments along the axis of the Government Point Syncline (see figs. 2, 3, 4) could reflect synclinal sedimentation during the Pliocene. The Government Point Syncline is a major structural element of the Late Pleistocene marine terraces in the Government Point Syncline. This regionally extensive syncline and many other, east-west-striking faults and faults probably are rooted in blind thrust faults and back-thrust faults in the hanging wall above the Pitas Point–North Channel Fault system (fig. 1–3 in pamphlet).

REFERENCES CITED

Dibblee, T.W., Jr., 1988a, Geologic map of the Lompoc Hills and Point Conception quadrangles, Santa Barbara County, California (H.E. Ehrenspeck [1988] and J.A. Minch [2009], eds.): Dibblee Geological Foundation Map DF-18, scale 1:24,000.

Fader, G.B.J., 1997, Effects of shallow gas on seismic-reflection profiles, in Davies, T.A., Bell, T., Cooper, A.K., Jacobowitz, H., Rohak, I., Salhoing, A., Stokoe, M.S., and Strayhorn, J.A., eds., *Gulfslope continents*, 115-130.

Hovland, M., and Judd, A.G. 1988. Seabed pockmark and seepages: London, Graham and Trotman, Inc., 293 p.

Mitchum, R.M., Jr., Vail, P.R., and Sangree, J.B. 1977. Seismic stratigraphy and global changes of sea level, part 6—Stratigraphic interpretation of seismic reflection patterns in depositional sequences, in Payton, C.E., ed., *Seismic stratigraphy—Applications to hydrocarbon exploration*: Tulsa, Okla., American Association of Petroleum Geologists, p. 117–133.

Redin, T., Forman, J., Kammerling, M., and Galloway, J., 2005, Santa Barbara Channel structure and correlation sections—CS-32 to CS-42: American Association of Petroleum Geologists, Pacific Section, Publication CS 36, 12 sheets.

Rockwell, T.K., Nolan, J., Johnson, D.L., and Patterson, R.H., 1992, Ages and deformation of marine terraces between Point Conception and Gaviota, Western Transverse Ranges, California, in Wehmiller, J.F., and Fletcher, C., eds., Quaternary coasts of the United States—Marine and lacustrine systems: Society of Economic Paleontologists and Mineralogists, p. 333–341.

Sorlien, C.C., and Nicholson, C., 2015. Post 1-Ma deformation history of the Pitas Point-North Channel-Red Mountain fault system and associated folds in Santa Barbara channel, California: U.S. Geological Survey National Earthquake Hazards Reduction Program final report, Award G14AP00012, 24 p., available at https://earthquake.usgs.gov/education/external_grants/reports/G14AP00012.pdf.

Stanford, J.D., Hemmingway, R., Rubing, E.J., Challener, P.G., Medina-Eizalde, M., and Lester, A.J., 2011. Sea-level projection for the last deglaciation—A statistical analysis of far-field records: Global and Planetary Change, v. 79, p. 193–203, available at <https://doi.org/10.1016/j.gloplacha.2010.11.002>.

792 p., 1992–2005, available at <https://doi.org/10.7101/gp.cpubdata.2010.11.002>.

Trizenberg, P., J. Hart, P. E., and Childs, J. R., 2016, National Archive of Marine Seismic Surveys (NAMSS)—A USGS data website of marine seismic reflection data within the U.S. Exclusive Economic Zone (EEZ): U.S. Geological Survey data release, accessed May 2016 at <https://doi.org/10.5066/7930R7P> [formerly U.S. Geological Survey's National Archive of Marine Seismic Surveys database, available at <http://walrus.wr.usgs.gov/NAMSS/>].

REFERENCES CITED

Dibble, T.W., Jr., 1988. *Geologic map of the Pompe Hills and Point Conception quadrangles, Santa Barbara County, California* (Hess 1988) and J.A. March (2003) eds.: *Dibble Geological Foundation Paper 12*, 1:250,000.

Fader, J.G., 1997. Effects of shell growth on seaker-reflection profiles. In Davies, T.A., Bell, T., Cooper, A.K., Johnathan, H., Polak, I., Schellum, A., Sotker, M.S., and Stravers, J.A., eds. *Glacially controlled erosion—An international perspective*, 107–116.

Hovland, M., and Vail, A.G., 1988. Seebed pebbles and seepages. *London, Graham and Trotman, Inc.*, 289 p.

Mitchum, R.M., and Vail, P.R., and Sangree, B.L., 1977. Seismic stratigraphy and concepts of sea level, part 1. *Geological Society of America Bulletin*, 88, 1706–1716.

Seismic Stratigraphy—Applications to Hydrocarbon Exploration: Tulsa, Oklahoma: American Association of Petroleum Geologists, p.117–133.

Rodriguez, J., Ferrus, A., and Gallegos, J., 2003. Santa Barbara Channel stratigraphy and correlation sections—CS-32 to CS-42: American Association of Petroleum Geologists, Pacific Section, Santa Barbara, 32, 12 sheets.

Shaw, N., Kolon, J., Johnson, D.L., and Patterson, R.H., 1992. Ages and formation of marine terraces between Point Conception and Gaviota, Western Transverse Ranges, California. In Wehlinger, J.J., and Flechter, C., eds. *Quaternary coasts of the United States—Marine and lacustrine systems*. Society of Economic Geologists, 1, 1–12.

Sorlien, C.C., and Nicholson, C., 2013. Post-13Ma deformation history of the Pinn Point-North Channel-Red Mountain fault system and associated folds in Santa Barbara channel (California, U.S.). *Geological Society of America Bulletin*, 125, 1497–1512. Available at: <http://pubs.geoscienceworld.org/gsa/gsaabstracts/gsa/2013/abstract/A110/P00012.pdf>.

Stanford, J.D., Henning, E., Rohlfing, E.J., Chaffin, P.G., Medina-Ezandue, M., and Foster, A.J., 2011. Sea-level rise and late Holocene sea-level effect on deltaic and coastal plain and planetary channels. *Geology*, 39, 119–120. available at: <http://www.sciencemag.org/cgi/content/full/39/1/119> [geology.2011.010262].

Trenberth, P.J., Hart, P.F., and Chide, J., 1997. The effect of sea level rise on the Pacific Seismic Zones (NASMS)—a preliminary report. *United States Geological Survey Bulletin*, 1249, 1–10. Available at: <http://pubs.usgs.gov/bulletin/1249/> [usgs.gov].

United States Geological Survey data release, accessed May 6 at 2016 at: <http://dx.doi.org/10.5060/67508077> (formerly U.S. Geological Survey National Earthquake Information Service Seismicity database, available at: <http://www.usgs.gov/data/data>).